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ABSTRACT

The relationship between high school sophomores' (N=214) self concepts in science and their science achievement, mental ability, and sex were investigated. The Self Concept in Science Scale was used as a measure of students' self concepts. Science achievement was measured by the students' tenth-grade final examination in biology. The measure of mental ability use was the Otis-Lennon Mental Ability Test (Advanced Form J). Demographic data were obtained from guidance folders and a student questionnaire. Results indicated that a relationship does not exist between students' self concept in science and a measure of science and mental ability and grades. The major conclusion drawn from the results of the study is that students who are high achievers in biology and who have high mental ability will have the highest self concept in science. This conclusion supports the theoretical construct that the perceptual field as perceived by the individual has a specific determining effect on behavior, as well as what may be assimilated into the self. (DS)

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AN ANALYSIS OF THE RELATIONSHIP OF STUDENTS' SELF CONCEPTS IN SCIENCE AND THEIR SCIENCE ACHIEVEMENT, MENTAL ABILITY, AND GENDER

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AN ANALYSIS OF THE RELATIONSHIP OF STUDENT' SELF CONCEPTS IN SCIENCE AND THEIR SCIENCE ACHIEVEMENT, MENTAL ABILITY AND GENDER

The purpose of this study was to further investigate (Doran and Sellers 1978) the relationship between students' self concepts in science and their science achivement, mental ability and gender. These relationships were viewed in the theoretical writings of Maslow (1951), the client-centered framework of Rogers (1954), and in the phenomenology of Snygg and Combs (1959).

Based on theoretical constructs and a review of relevant research, it was hypothesized that there would be a positive relationship between students' self concepts in science and a measure of achievement in science and their mental abilities. It was further postulated that students' self concepts in science would be positively related to measured achievement in science when mental ability was partialled out. In addition, males were hypothesized to have higher self concepts in science than females.

All subjects (N=214) were chosen from the sophomore class of a central public high school located in an urban community of Western New York. The Self Concept in Science Scale (SCSS) was used as a measure of students' self concepts in science. Science achievement was measured by the students' Tenth Grade Final Examination in Biology. The measure of the mental ability used was the Otis-Lennon Mental Ability Test, Advanced Form, J. Demographic data was obtained from guidance folders and a student questionaire.

An analysis of the data was made by a stepwise multiple regression. The results appear to confirm the hypothesis that a relation does exist between students' self concepts in science and a measure of science achievement and their mental ability and gender. Bivariate correlations between the criterion variables of self concept in science and the predictor variables of measured biology achievement and mental ability were significant and positive (α=.05). The bivariate correlation between self concept in science and gender was not significant. The hypothesized relationship between students' self concepts in science and their "differential achievement" (mental ability partialled out) and grades were supported by the data obtained.

The major conclusion drawn from the results of the study is that students who are high achievers in biology achievement and who have high mental ability will have the highest self concepts in science. This conclusion supports the theoretical construct that the perceptual field as perceived by the individual has a specific determining effect on behavior, as well as what may be assimilated into the self. The person with a positive self concept in science can enter the science classroom expecting to be successful, and, therefore, act in ways that will bring about success. The individual expecting failure will have a limited number of alternatives to choose from in a problematic situation.

An Analysis of the Relationship of Students' Self Concepts in Science and Their Science Achievement, Mental Ability, and Gender.

Introduction

The purpose of this study was to further investigate (Doran and Sellers, 1978) the relationship between tenth grade biology students' self concepts in science and their science achievement, mental ability, and gender. Student self concept in science was treated as the criterion variable and a measure of tenth grade biology achievement, mental ability, and gender as the predictor variables.

One of the major concerns in education today is the development of a student's self concept and those factors that influence its formation. It is the student's self concept that provides the basis for meeting and surviving a future world dominated by change as influenced by our scientific-technological developments. The theoretical background of the client-centered framework of Rogers (1951), the writings of Maslow (1954), the phenomenology of Combs and Snygg (1959), and instruments developed by Fitts (1965) formed the basis of investigation for this study.

Research Question

Based on the theoretical framework and a review of the literature, the major research questions for this study are the following:

1. Is there a relationship between students' self concepts in science and their biology achievement, mental ability, and gender?

11. Is there a relationship between students' self concepts in science and their differential achievement and gender?

Instruments

The instruments used in the study were the Self Concept in Science Scale, Otis-Lennon Mental Ability Test, From J, and a student questionnaire. Science achievement was ascertained by using the student's final examination scores in tenth grade biology. The instruments used in the study are thoroughly described in Doran and Sellers (1978).

Subjects

The subjects in the investigation attend a comprehensive high school of approximately 1600 ninth to twelfth grade students in a community of 20,000 people adjacent to a large city in western New York. A majority of the approximately 5,500 families living in the community were of the lower middle class.

Data collection was obtained from those students taking biology during the 1978-80 academic school year. All students in the sample were Caucasian and were representative of a wide variety of ethnic backgrounds. Comparsions of the mean mental ability of the subjects to the national norms were found to be quite similar. Approximately equal numbers of male and female students were used in this investigation.

Research Question I

The first research question investigated in this study was the relationship between the criterion variable of student self concept in science and the predictor variables of biology achievement, mental ability, and gender (see Table I).

TABLE I

Regression Analysis for the Relationship Between the Predictor Variables of Biology Achievement, Mental Ability, Gender and the Criterion Variable of Self Concept in Science

Predictor Variable(s) and Self Concept in Science	df	F Ratio	R^2
Biology Achievement	1,212	34.20[a]	.139
Biology Achievement, Mental Ability	2,211	26.21[a]	.199
Biology Achievement, Mental Ability, Gender	3,210	17.60[a]	.201

[a]Significant, p=.05.

From the results of the multiple regression data in Table I, the null hypothesis was rejected. It was concluded that a relationship existed between the variables of biology achievement, mental ability, gender and self concept in science. The strength of the relationship, as denoted by the squared multiple correlation coeffieient, may be described as moderate. 20% of the variance in the self concept of science variable was explained by the predictor variables.

Having established the existence of the relationship, the nature of the relationship was next examined. Based on the data presented in Table II, a number of correlations were ascertained to be significant. An r of >.16 was necessary for the correlation to be significantly different for zero. Positive correlations were obtained between self concept in science and biology achievement (.33) and mental ability (.35). The hypothesized relationship of males having a higher self concept in science than that of females was not substantiated. The only other significant correlation that was revealed in the study was the expected strong

relationship of mental ability and biology achievement (.40).

Table II

Estimated Correlation Matrix of the Predictor and Criterion Variables Based on 214 Subjects

Variable	1	2	3	4
1. Biology Achievement	1.00	.40[a]	.01	.33[a]
2. Mental Ability		1.00	-.14	.35[a]
3. Gender			1.00	.02
4. Self Concepts in Science				1.00

t= 1.96, df= 212, p=.05.
[a]Significant

Research Question II

The second research question investigated the relationship between students' self concepts in science and differential biology achievement (mental ability partialled out) and gender. As in research question I, a multiple regression analysis was performed. From the data in Table III, it was concluded that differential biology achievement and gender were useful in the prediction of students' self concepts in science. Science the existence of the relationship between the predictor variables and the criterion variables was established research question II, stated in the null form was rejected.

Table III

Regression Analysis for the relation Between the Predictor Variables of Differential Biology Achievement and Gender and the Criterion Variable of Self Concept in Science.

Predictor Variable(s) and Self Concept in Science	df	F Ratio	R^2
Differential Biology Achievement	1,212	34.20[a]	.139
Differential Biology Achievement and Gender	2,211	17.02[a]	.139

[a]Significant, p=.05.

Summary

As in the 1978 study by Doran and this investigator, the results of the data demonstrated that science achievement, mental ability, and gender were useful in predicting students' self concepts in science. In the 1978 study, the prediction of the combined variables accounted for approximately 9% of the total variation in students' self concepts in science. The predictive ability in the present study was somewhat better in that over 20% of the variance was explained. It may be concluded that higher levels of science achievement and mental ability are related to higher levels of students' self concepts in science. In addition, the data for research question II indicated that even when the mental ability contribution was removed from consideration, a significant combined predictive value was indicated between differential science achievement and gender and students' self concepts in science.

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SELF CONCEPT IN SCIENCE SCALE

INSTRUCTIONS

On the top of the separate answer sheet, fill in all of the heading except the identification number. Write only on the answer sheet. Do not put any marks on the question sheets.

The statements on the following pages are to help you describe yourself as you see yourself in science. Please respond to them as if you were describing yourself to yourself. Do not omit any item. Read each statement carefully; then select one of the five responses listed below.

On your answer sheet darken the space of your response number that you have chosen for each statement. Be sure to use the NUMBER 2 PENCIL provided for you. If you decide to change an answer, erase your first answer completely and then darken in the space of your new response.

The responses are as follows:

Completely false	Mostly false	Partly false and partly true	Mostly true	Completely true
1	2	3	4	5

Remember, respond to the statements as if you were describing yourself to your self in science.

You will find the response numbers repeated at the bottom of each page to help you remember them.

PART I

1. I measure things as well as I would like to.
2. I am a person who can think about what I have observed and come up with a good conclusion.
3. I always try to carefully notice what we do in class.
4. I am satisfied with my ability to describe the differences and similarities between things.
5. I am a person who is able to put things into groups.
6. I try to measure things carefully.
7. I am satisfied with my ability to observe what is done in an experiment.
8. I am a good experimenter.
9. I am satisfied with my ability to make predictions.
10. I do well on number problems in class.
11. I wish I could make better conclusions based on what I have seen in class.
12. I am a person who works well with numbers.
13. I can compare things.
14. I give up when I have to classify things.
15. I am a good observer.
16. I am a person who is able to measure things.
17. I am satisfied with the way that I do experiments.
18. I know that I compare things very well.
19. I can make good generalizations.
20. I am never satisfied with my ability to classify things into groups.
21. I can make predictions.
22. I am satisfied with my ability to work with numbers.
23. I am a person who is able to predict things.
24. I do experiments well in science class.

RESPONSES

Completely false	Mostly false	Partly false and partly true	Mostly true	Completely true
1	2	3	4	5

(17)

PART II

25. I am a loner in science class.
26. I try to learn a lot when I go on a field trip.
27. I wish that I could be a better reader.
28. I am satisfied with my ability to learn well from movies and filmstrips.
29. I try to take good notes in class.
30. I use the science books that we have in our library.
31. I am the kind of person who does well on individual projects.
32. I ought to do better than I do on my science tests.
33. I do well when I just have to memorize something.
34. I am a good reader.
35. I ought to listen more closely to what my teacher says in class.
36. I am <u>not</u> the type of person who gains a lot from going on a field trip.
37. I wish that I could do better in class discussions.
38. I learn well from other students.
39. I am the type of person who learns from watching demonstrations.
40. I am <u>not</u> a good note taker.
41. I am satisfied with my ability to memorize.
42. I never put materials and equipment together for science experiments.
43. I learn well when I listen to my teacher.
44. I am satisfied with what I learn from the demonstrations given in science class.
45. I discuss well in class.

RESPONSES

Completely false	Mostly false	Partly false and partly true	Mostly true	Completely true
1	2	3	4	5

(12)

46. I sometimes do poorly in reading.
47. I wish that I could take better notes.
48. I do my best work when I am working on an individual project.
49. I am not satisfied with the way that I put materials and equipment together for science experiments.
50. I am able to learn well from listening to my teacher.
51. I wish I could gain more from going on a field trip than I do.
52. I do as well as I want to on individual projects.
53. I know that I put materials and equipment together well for science experiments.
54. I do not understand some things in class because I do not pay attention to the demonstrations.
55. I am a person who has the ability to use science reference books.
56. I wish that my classmates liked me better.
57. I know that I have the ability to learn well from movies and filmstrips.
58. I am a good test taker.
59. I always try to learn from movies and filmstrips in science class.
60. I am a person who could just about memorize anything.
61. I am satisfied with the way that I can use science reference books.
62. I give up when I take tests.
63. I am the kind of person who does poorly in class discussions.

RESPONSES

Completely false	Mostly false	Partly false and partly true	Mostly true	Completely true
1	2	3	4	5

SELF CONCEPT IN SCIENCE SCALE (SCSS)

PROCESS	IDENTITY	SELF SATISFACTION	BEHAVIOR
Observing	15	7	3
Comparing	18	4	13
Classifying	5	20*	14*
Quantifying	12	22	10
Measuring	16	1	6
Experimenting	8	17	24
Predicting	23	9	21
Concluding	2	11*	19
METHODS AND TECHINQUES			
Readings	34	27*	46*
Listening to teacher	50	35*	43
Taking Notes	40*	47*	29
Individual projects	31	52	48
Class Interaction	25*	56*	38
Test Taking	58	32*	62*
Multi-media	57	28	59
Demonstrations	39	44	54*
Memorizing	60	41	33
Class discussion	63*	37*	45
Field Trips	36*	51*	26
Library and reference work	55	61	30
Working with materials and equipment	53	49*	42*

PART I - Process Questions 1 - 24

PART II - Method and Technique Questions 25 - 63

* Negative questions

SOME THOUGHTS ON THE TOPIC OF SELF CONCEPT AND SOME APPLICATIONS IN THE SCIENCE CLASSROOM

1. The teacher and the student are working toward the same goal, "helping the student become all that he is capable of becoming".

2. Develop mutual respect among students in the classroom, as well as between you and your students.

3. Mental ability may be increased when an individual has increased richness and variety of percepts.

4. Try to eliminate "threat" within your classroom. In a threatening classroom a student's self concept can not grow.

5. Help the student see that he is worthwhile, no matter what is his past record.

6. When evaluating a student use the general rule that if the evaluation will enhance the self concept, use it, if it will not, reject it.

7. A good deal of teacher time must be spent "believing in" and "supporting" your students.

8. Use the lab to give challenging yet successful experiences for your students.

9. Let nature help you in giving feedback to your students. In that way you will not be be the only one giving positive reinforcement.

10. Have students work in lab teams so that success will be more probable.

11. Use relevant material. Let students discover new understandings about themselves.

12. Use learning contracts. Especially ones where the students know exactly how they will be graded.

13. Use hypothesis testing.

14. Remember: learning is a case of perceiving things differently.

15. To increase personal meaning for students we must decrease the distance from the "not-self" to "self".

16. Enjoy yourself when you teach, it rubs off on your students.

17. Help your students set high yet obtainable goals. If you do not expect much from your students they will in turn not accomplish very much.

18. Be pleased with a good attempt.

19. Accept the student as he is.

20. Use the class to help bolster a student's self concept.

21. Don't simply tell the student that he is wrong. Tell him also that his behavior would be more appropriate in another setting.

22. Don't use tests or grades as punishment.

23. Use grades for diagnostic purposes. Some students with the threat of a grade are unwilling to try something new. They just won't take the chance.

24. Help students see that the purpose of a grade is to report on their achievement in school and their progress in meeting educational goals.

25. Use a student's questions as a signal of his readiness for an experience, a chance to learn.

26. Student's self concepts are "shapable". This is very true in the early grades, but less so at the high school level.

27. After meeting a defeat, there is a very large difference in which of the following statements a student makes:

"I have failed."
"I am a failure."

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Self Concept - Reading List

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